determined based on training images" indefinite because the training images could either be the same or different sets of the facial images. Stated differently, there is no ambiguity and it is respectfully submitted that the Office Action may be confusing ambiguity with breadth of claim. the claims can encompass embodiments where the training images used in the first LDA transformation are the same as used in the second LDA transformation, or they can be different.

Also, the Office Action suggests that there is "no connection [] made between the face images stored in the face DB to the training images, leading the claims to read as all being separate images." Applicants reiterate that the Office Action may be confusing breadth with clarity. Here, it is true that the face image database as recited in the last recitation of claim 10, for instance, is used in determining similarities between an input query face image and face images stored in the face image database by comparing a face descriptor of the input query face image with the face descriptors of face images stored in the face image DB. The face descriptors of the face images stored in the face image DB have clear antecedent basis as to the face descriptors resulting from the second LDA transformation. These may be the training images, but then the training images can simply be a subset of the total set of face images. Hence, Applicants' use of "face images" and "training images" is both consistent and appropriate under the circumstances.

In light of the foregoing comments, Applicants respectfully request reconsideration and withdrawal of the rejection under 35 U.S.C. § 112, second paragraph.

35 U.S.C. § 103

The Office Action includes a rejection of claims 10-12, 14, 17, 29, 30, 33, 36 and 37 under 35 U.S.C. § 103(a) as allegedly not being patentable over "Mosaic Image Method: A Local And Global Method" by Li Zhao and Yee-Hong Yang ("*Zhao*") in view of "Eigenfaces vs. Fisherfaces: Recognition Using Class Specific Linear Projection" by Peter N. Belhumeur, João P. Hespanha, and David J. Kriegman ("*Belhumeur*"); a rejection of claims 1-3, 5, 8, 19, 20, 23, 26 and 27 under 35 U.S.C. § 103(a) as allegedly being unpatentable over the purported combination of *Zhao* and *Belhumeur* in view of "Generalized Discriminant Analysis Using a Kernel Approach" by G. Baudat and F. Anouar ("*Baudat*"); a rejection of claims 15, 16, 34 and 35 under 35 U.S.C. § 103(a) as allegedly not being patentable over the purported combination of *Zhao* and *Belhumeur* in view of "Multiresolution Eigenface-Components" by A.Z. Kouzani, F. He, and K. Sammut ("*Kouzani*"); a rejection of claims 6, 7, 24 and 25 under 35 U.S.C. § 103(a) as allegedly not being patentable over the purported combination of *Zhao*, *Belhumeur*, *Baudat* in view of *Kouzani*; a rejection of claims 13 and 31 under 35 U.S.C. § 103(a) as allegedly not being patentable over the purported combination of *Zhao* and *Belhumeur* in view of U.S. Patent No. 6,567,771 to *Erdogan et al*. ("*Erdogan*"); a rejection of claims 4 and 21 under 35 U.S.C. § 103(a) as allegedly not being patentable over the purported combination of *Zhao*, *Belhumeur*, and *Baudat* in view of *Erdogan*; a rejection of claim 32 under 35 U.S.C. § 103(a) as allegedly not being patentable over the purported combination of *Zhao* and *Belhumeur* in view of U.S. Patent Application Publication No. 2004/0066953 to *Bock*; and a rejection of claim 32 under 35 U.S.C. § 103(a) as

allegedly not being patentable over the purported combination of *Zhao*, and *Belhumeur* in view of *Bock*. These rejections are respectfully traversed.

It is respectfully submitted that *Zhao*, whether viewed alone or in combination with *Belhumeur* does not meet each and every recitation of claims 10-12, 14, 17, 29, 30, 33, 36 or 37.

<u>*Zhao*</u>

Zhao discloses a method for performing image recognition system using principal component analysis ("PCA"). The method includes slicing images into a mosaic of equal-sized images, generating local eigenvectors using "PCA", and forming global eigenvectors from the local eigenvectors. (*Zhao*, p. 1423, ¶ 3.) Image recognition is performed based on global eigenvectors by comparing training images with a test image. (*Zhao*, p. 1427, § 5.)

More specifically, in Zhao, a vector vi,j is generated by raster scanning the mosaic images. (Zhao, p. 1424, ¶ 1.) By concatenating these vectors, a vector V for the whole image is produced. (Id.) Then, applying PCA to each mosaic vi,j, local eigenvectors $\Phi_t^{i,j}$ are computed. (*Zhao*, p. 1424, ¶ 2.) By concatenating eigenvectors $\Phi_t^{i,j}$ according to the relative positions of the corresponding mosaic images, global eigenvectors Φ_t are generated. (*Id.*) Thus, the method disclosed by *Zhao* includes <u>PCA</u> to generate local eigenvectors $\Phi_t^{i,j}$ from mosaic images. However, the global eigenvector Φ_t is generated by <u>concatenation</u> and not by PCA or other such algorithm.

The Office Action relies on *Zhao* for its alleged disclosure of an image recognition system that uses the principle component analysis that the Office Action suggests includes two transformation: one transformation of a model (i.e., the Office asserted "training" image) and a second transformation of a new image, which is compared to the model image of the first transformation. The chart below indicates the Examiner's asserted correspondence between the claim recitations of claim 10 and the disclosure of *Zhao*.

Claim 10	*Zhao et al.*
An apparatus for retrieving face images using combined component descriptors, comprising:	
an image division unit for dividing an input image into facial components;	"We believe that the recognition of an object is feature based, and that the feature is a local property, which depends only on a small neighborhood of pixels. The relative positions of these features give the whole structure of topology of the object. Applying this view to PCA, only the correlation of the local pixels need to be accounted for and a method called the *mosaic image method* is proposed (Fig. 1). In the mosaic image method, images are sliced into equal small-dimensional mosaic images. Local eigenvectors are generated by accounting for the local correlation in these small mosaic images. Global eigenvectors are formed by these local eigenvectors according to the relative positions of these mosaic images."
a first LDA transformation unit for LDA transforming the divided facial components into a component descriptors of the facial components using a first LDA transformation algorithm determined based on training images;	"We believe that the recognition of an object is feature based, and that the feature is a local property, which depends only on a small neighborhood of pixels. The relative positions of these features give the whole structure of topology of the object. Applying this view to PCA, only the correlation of the local pixels need to be accounted for and a method called the *mosaic image method*

	is proposed (Fig. 1). In the mosaic image method, images are sliced into equal small-dimensional mosaic images. Local eigenvectors are generated by accounting for the local correlation in these small mosaic images. Global eigenvectors are formed by these local eigenvectors according to the relative positions of these mosaic images." * * * To recognize, a model of the object must be set up. In the context of PCA-based vision systems, this model includes projections of the sample images in the eigenspace and the eigenimages themselves. In the mosaic image method, the model includes the projection vectors and the new representation. A simple recognition algorithm is used to apply this model. This simple algorithm can accommodate up to 53% occlusion and achieves more than 95% recognition rate.
a vector synthesis unit for synthesizing the transformed component descriptors into a single vector;	We believe that the recognition of an object is feature based, and that the feature is a local property, which depends only on a small neighborhood of pixels. The relative positions of these features give the whole structure of topology of the object. Applying this view to PCA, only the correlation of the local pixels need to be accounted for and a method called the *mosaic image method* is proposed (Fig. 1). In the mosaic image method, images are sliced into equal small-dimensional mosaic images. Local eigenvectors are generated by accounting for the local correlation in these small mosaic images. Global eigenvectors are formed by these local eigenvectors according to the relative positions of these mosaic images. Applying PCA to <u>each mosaic</u> $v_{i\,j}$, eigenvectors $\Phi_t^{i,j}$ (t = 0,1. ..., mn - 1; i = 0,1. ... r - 1; j - 0.1. ... . c - 1) can be

	computed (these eigenvectors are sorted by non-increasing order). By concatenating these eigenvectors according to the relative positions of corresponding mosaic images, principal components for the whole image result: Φ_t = [Equation 4) This is a new *global* representation of the whole image. Yet the method to generate new eigenimages is via computing local correlations. This is the reason that this method is a local and global method.
a second LDA transformation unit for LDA transforming the single vector into a single face descriptor using a second LDA transformation algorithm determined based on training images; and	Applying PCA to <u>each mosaic</u> $v_{i\,j}$, eigenvectors $\Phi_t^{i,j}$ (t = 0,1. ..., mn - 1; i = 0,1. ... r - 1; j - 0.1. ... . c - 1) can be computed (these eigenvectors are sorted by non-increasing order). By concatenating these eigenvectors according to the relative positions of corresponding mosaic images, principal components for the whole image result: Φ_t = [Equation 4) This is a new *global* representation of the whole image. Yet the method to generate new eigenimages is via computing local correlations. This is the reason that this method is a local and global method. One *interesting and important* thing is about the property of the global representation. According to principal component analysis, the global representation generated by treating an image as a whole is the optimum representation. Therefore, although Φ_i 's form part of the basis in the same *LW*-dimensional space $IR^{1.W.}$, they are certainly not the optimum basis in the context that the image is treated as a whole, i.e., Φ_i 's are used as a whole in the reconstruction and recognition stage.

	This is verified by experiments presented later. However, this way to apply the new representation Φ_i , is certainly not the best way since they are generated locally and globally. Later, experimental results show that using this representation either purely locally or purely globally gives poor performance. However, using this representation both locally and globally gives very good performance. In the mosaic image method, Φ_i 's are applied locally and globally. The input image rafter subtracting the mean image from it is sliced into mosaic images in the same way by which the new representation is generated. The *projection vector* of the input image is therefore [Equation 6] where i = 0.1, ...r (r is the number of principal components used). In this simple recognition algorithm, if N sample images are used in the training stage and x eigenimages are used in the recognition stage, then there are x projection vectors for every training image. Therefore, there are a total of N's projection vectors in the model. They are denoted as [Equation 9]
a similarity determination unit for determining similarities between an input query face image and face images stored in an face image database (DB) by comparing a face descriptor of the input query face image with face descriptors of the face images stored in the face image DB.	For every mosaic image in the new input image, the distance from the projections of the new image and the models are computed by Euclidean norm: [Equation 11]

It is respectfully submitted that the Office Action may be misinterpreting the present claims. For instance, claim 10 recites a first LDA transformation algorithm. This first LDA transformation algorithm is determined based on training images. However, as far as the undersigned can tell, the *algorithm* of *Zhao* is not *determined* based on training images. The mosaic image method of *Zhao* is said to slice an image into equal small dimensional mosaic images and local eigenvectors are generated by counting for the local correlation between these small mosaic images. Global eigenvectors are formed by these local eigenvectors according to the relative position of the mosaic images. PCA is applied to each mosaic such that eigenvectors can be computed, according to page 1424, second full paragraph. These mosaic eigenvectors are concatenated to result in principle components for the whole image. However, in comparing the recitations regarding the second LDA transformation, as with the first LDA transformation, one cannot see that the *Zhao* reference discloses a second LDA transformation algorithm that is *determined* based on training images. In fact, as captioned in the table above, a projection vector global representations data Φ are applied locally and globally the input image (after subtracting the mean image from it) is sliced into mosaic images in the same way in which a new representation is generated and the projection vector of the image is therefore equation 6 as appears on page 1424. Again, one cannot see a correlation between the cited passages of the *Zhao* article and the recitations of claim 10.

While Applicants appreciate the Examiner's point citation to various paragraphs of the *Zhao* patent, it would facilitate the consideration by the Applicant if the Examiner could explain how the Examiner is interpreting these paragraphs to meet these very specific recitations in the independent claims.

Belhumeur et al.

It is noted that *Belhumeur et al.* is disclosed for allegedly disclosing that LDAs can be replaced for PCAs. Even if one were to accept this suggestion, the hypothetical result would still not be the claim recitations for the reasons given above.

It is also respectfully submitted that the arguments presented above are equally applicable to each of the independent claims as they contain similar or identical recitations.

Baudat

With respect to *Baudat*, the Office suggests that it discloses using GDA as a means to carry out LDA (page 1, paragraph 1). Again, even assuming *arguendo* that one could first substitute PCA with LDA and then substitute LDA for GDA, it would not meet the recitations of the claims for the reasons given above. Furthermore, it seems arbitrary to suggest that one of ordinary skill in the art would first substitute PCA for LDA and then selectively substitute a second LDA transformation for a GDA transformation while leaving the first LDA transformation untouched. As the prior art does not teach the first and second LDA transformations as recited in the claims, it is respectfully submitted that in hypothetical combinations the prior art does not meet the claim recitations. However, it is also challenged that one would selectively choose first to substitute PCA for LDA and then selectively use GDA instead of LDA in one transformation but not the other. This selection can only be based on an

attempt to meet the claim recitations by using the claims as a template to selectively extract features from the prior art in order to meet the claim recitations.

Kouzani

With respect to *Kouzani*, *Zhao* does not actually specifically mention face components let alone that they partially overlap each other. In fact, it would seem that *Zhao et al.* would not permit the individual mosaic images to overlap in its system as it is described. *Kouzani* is cited for allegedly teaching a different way of dividing face images in different features, "which partially overlap each other". Reliance on an illustration in an article does not seem a sufficient basis to deny the patentability of claims, nor does it suggest combinability simply because they are in the same field of endeavor. Further, the undersigned does not see the images overlapping in Fig. 1 of Kouzani. It is repeated that *Zhao* does not seem to accommodate overlapping images nor is there any sense in either document permitting the images to overlap would result in "more accurate recognition by providing full information for each feature" as hypothesized by the Examiner, insofar as this suggestion is only found in Applicants' disclosure.

Erdogan et al.

With respect to *Erdogan et al.*, it is applied for suggesting that it is well known that when training a pattern recognition system during LDA process, a number of matrices are determined in use to determine transformation matrix. However, *Zhao et al.* actually disclose a PCA process that even if one were to assume that it would involve an LDA process, it is not clear why *Erdogan et al.* would provide a teaching

that would result in "the most accurate LDA recognition by being able to find the relationship between the model images and the input image" any better than *Zhao et al.* already discloses if one were to accept the substitution of the LDA for PCA in accordance with the Examiner's suggestion.

Bock

Finally, with respect to *Bock*, even if one were to assume *arguendo* that *Bock* discloses outputting face images of an identified face of a person, a hypothetical combination would still not teach the present invention for the reasons given above.

In light of the foregoing, Applicants respectfully request reconsideration and allowance of the above-captioned application.

Conclusion

In light of the foregoing, Applicants respectfully request entry of this Reply to Office Action and the Examiner's reconsideration and allowance of the above-captioned application.